Airway Foreign Body in Children

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Learning Objectives

- Identify clinical situations that may require alternative management strategies for the airway.
- Determine airway management safety with foreign body removal techniques other than traditional endoscopy such as removal in the radiology suite by an interventional radiologist.
- Understand particular foreign bodies of interest that present increased and often unidentified airway risks such as the increasing incidence of esophageal disc battery ingestions with erosion into the airway.
Airway Foreign Body in Children

- Is the topic important?
  - Airway foreign bodies are the fifth leading cause of death in children less than one year of age. [Bittencourt PF, Camargos PA, Scheimann P, de Blic J. Foreign body aspiration: clinical, radiological findings and factors associated with its late removal. Int J Pediatr Otorhinolaryngol. May 2006;70(5):879-84. [Medline]]

- Mortality occurs due to acute aspiration.
  - Morbidity can occur due to acute hypoxia during the acute episode or due to chronic lung and airway damage from a long-standing aspirated foreign body.

- The highest incidence occurs in children 1 to 3 years old with most being either 1 or 2 years of age.
  - Toddlers up to pre-schoolers
  - Male predominance
Airway Foreign Body in Children

History

- Often, the child presents after a sudden episode of coughing or choking while eating with subsequent wheezing, coughing, or stridor.
- However, in numerous cases, the choking episode is not witnessed, and, in many cases, the choking episode is not recalled at the time the history is taken.

Airway Foreign Body in Children

History

- The most tragic cases occur when acute aspiration causes total or near-total occlusion of the airway, resulting in death or hypoxic brain damage.

Airway Foreign Body in Children

History

- The more difficult cases are those in which aspiration is not witnessed or is unrecognized and, therefore, is unsuspected.
- In these situations, the child may present with persistent or recurrent cough, wheezing, persistent or recurrent pneumonia, lung abscess, focal bronchiectasis, or hemoptysis.
- If the material is in the subglottic space, symptoms may include stridor, recurrent or persistent croup, and voice changes.
Airway Foreign Body in Children
Physical Examination

• Major findings include new abnormal airway sounds, such as wheezing, stridor, or decreased breath sounds.
• These sounds are often, but not always, unilateral.

• Sounds are inspiratory if the material is in the extrathoracic trachea.
• If the lesion is in the intrathoracic trachea, noises are symmetric but sound more prominent in the central airways.
• These sounds are a coarse wheeze (sometimes referred to as expiratory stridor) heard with the same intensity all over the chest.

• Once the foreign body passes the carina, the breath sounds are usually asymmetric.
• Remember that the young chest transmits sounds very well, and the stethoscope head is often bigger than the lobes.
• A lack of asymmetry should not dissuade the observer from considering the diagnosis.
• Similarly, a lack of findings upon physical examination does not preclude the possibility of an airway foreign body.
Airway Foreign Body in Children
Diagnostic Pearls

• What if standard auscultatory chest evaluation is normal but airway foreign body index of suspicion remains high
• Any other tricks for physical examination?

Airway Foreign Body in Children
Diagnostic Pearls

• Double-headed stethoscope
• Try it...
• I promise you will like it...
• No comparison for diagnostic sensitivity

Airway Foreign Body in Children
Diagnostic Pearls

• Children with airway foreign bodies have:
  – Normal radiography
  – Obstructive Emphysema
  – Air Trapping
  – Hyperinflation
  – Atelectasis
  – Consolidation
Airway Foreign Body in Children
Diagnostic Pearls

• Children with airway foreign bodies have:
  – Normal radiography
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ABC of Reading Chest X-ray

• Usually early partial or progressive ball-valve obstruction

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Airway Foreign Body in Children
Diagnostic Pearls

- 2-year-old boy with recurrent episodic fever and productive cough diagnosed as recurrent pneumonia.
- Chest radiograph shows atelectasis in right lower lobe.

Children with airway foreign bodies have:
- Normal radiography
- Obstructive Emphysema
- Air Trapping
- Hyperinflation
- Atelectasis
- Consolidation
  - Usually late finding signifying complete occlusion with air resorption.

Radiolucent foreign body trouble shooting
- AP CXR normal
- Very young child
- Which x-ray may help you?
Airway Foreign Body in Children
Diagnostic Pearls

• Left side down decubitus chest x-ray
• Interpretation?

Airway Foreign Body in Children
Diagnostic Pearls

• Left side down decubitus chest x-ray
• Patient did not have a foreign body
• Normal!!!

Airway Foreign Body in Children
Diagnostic Pearls

• Right side down decubitus film
• Interpretation?
Airway Foreign Body in Children
Diagnostic Pearls

• Right side down decubitus film
• Foreign-body aspiration on the right side
• Abnormal with air trapping on right!

Airway Foreign Body in Children
Diagnostic Pearls

• Standard AP and left lateral chest x-rays are normal
• Older cooperative child
• Might any other plain x-rays help?

Airway Foreign Body in Children
Diagnostic Pearls

• PA inspiratory and expiratory chest x-rays
• The inspiratory view demonstrates hyperexpansion of the right hemithorax
• The right hemithorax is blacker than the left
• The right hemithorax is also bigger than it should be
• Lung markings are evident throughout both lungs making this incompatible with a pneumothorax
• The expiratory view shows some collapse of the left lung, but persistent hyperexpansion of the right lung
Airway Foreign Body in Children
Diagnostic Pearls

- If plain radiography fails, can any other imaging studies help?

- Fluoroscopy of the chest may be helpful in showing focal air trapping, paradoxical diaphragmatic motion, or both.
- If one still has no diagnosis, any other imaging studies?
Airway Foreign Body in Children
Diagnostic Pearls

- Chest CT scanning may reveal the material in the airway, focal airway edema, or focal over-inflation not detected using plain radiography.
- If the index of suspicion is high, many physicians forgo CT scanning and proceed to the more definitive study, bronchoscopy.
- The use of CT scanning in managing the child with a foreign body in the airway has recently been questioned.
- Even if no foreign body is evident on any of the radiographic studies, a foreign body may still be present, and a bronchoscopy should be performed if the suspicion is high.

Airway Foreign Body in Children
Beware!

- What feature(s) deems this an URGENT airway emergency?
- What is the diagnosis?

Airway Foreign Body in Children
Beware!

- AP Chest film illustrating double contour feature of button battery
- Lateral chest film. Note difficulty differentiating between button battery vs. coin
- May see step-off with smaller diameter representing negative pole on lateral
- More tissue injury adjacent to negative pole
- 2 hours b/4 serious injury occurs
- CANNOT WAIT FOR NPO VIOLATIONS!!!
Airway Foreign Body in Children
Beware!

- Anterior–posterior and lateral view of 3-year-old female with suspected esophageal foreign body.
- Note step-off on lateral view and halo effect on anterior–posterior view from battery casing.
- Negative pole (anode) facing airway
- Potential posterior tracheal injury
- Anesthesiologist should make this assessment

Airway Foreign Body in Children
Controversies

- Non-endoscopic removal
- Chest physiotherapy and bronchodilators
- Flexible vs. Rigid endoscopy
- Impacted esophageal foreign body causing airway compression

Airway Foreign Body in Children
Controversies

- Non-endoscopic removal
  - Detrimental increasing degree of difficulty for standard removal
  - Has directly resulted in acute airway obstruction
  - Several reported deaths
  - Role/comfort of anesthetist in the radiology suite for these procedures?
Airway Foreign Body in Children
Controversies

• Chest physiotherapy and bronchodilators
  — Bad idea
  — Don’t do it!!!

— Chest physiotherapy and bronchodilators are not recommended for children with foreign bodies in the airway. It is important to avoid these treatments as they may cause further harm.

Airway Foreign Body in Children
Controversies

• Flexible bronchoscopic removal of airway foreign bodies seems attractive
• More recent literature advocating its use in adults
• Increasing experience in pediatrics as a diagnostic tool

— Flexible bronchoscopies are becoming more popular in adults due to their effectiveness in removing foreign bodies from the airway. However, it is crucial to note that the same procedure may not be suitable for children, especially very young ones. The endoscopist must be skilled in rigid bronchoscopy as well.

Airway Foreign Body in Children
Controversies

• Unless the endoscopist also is skilled at rigid bronchoscopy, flexible bronchoscopic foreign body removal in children is not recommended
• Especially in small children!!!
• The main problems are poor control of the airway and of the foreign body itself

— It is critical for the endoscopist to be proficient in both rigid and flexible bronchoscopies to perform foreign body removal in children successfully. The risk of complications is high, and control of the airway and foreign body is vital. Even in small children, these procedures can be challenging and should be approached with caution.
Airway Foreign Body in Children

Controversies

- For impacted esophageal foreign bodies, bougienage with esophageal dilators or a nasogastric tube has been proposed to push foreign bodies into the stomach
- This blind technique may cause esophageal injury

Don’t Forget Tracheotomy When...

- Large foreign body is lodged in the subglottis/proximal trachea
- Foreign body too big/sharp to pass glottis
- Significant laryngeal edema

Distal Airway Foreign Bodies

A young child presented to the hospital with an episode of coughing and oxygen desaturation. What is the diagnosis?
A young child presented to the hospital with an episode of coughing and oxygen desaturation. What is the diagnosis?

- AP chest X-ray revealing tooth in right hilum

Distal Airway Foreign Bodies

- Rigid bronchoscopy performed
- Mask induction
- Spontaneous ventilation
- No evidence of foreign body
- Did the anesthesiologist advance it with assisted mask ventilation?
- What do we do?

Distal Airway Foreign Bodies

- Flexible fiberoptic bronchoscopy (3.5 mm) performed
- Mask induction
- Maintenance anesthesia with LMA
- What do you see and now what do we do?
Distal Airway Foreign Bodies

- Tooth enmeshed in granulation in inflamed tertiary segment within right upper lobe distal bronchus
- The tooth could not be removed using instruments passed through the sideport of the bronchoscope including balloon catheters, ureteral baskets, and biopsy forceps
- The catheters were too compliant to reach the upper lobe and the forceps could not engage the tooth.
- What do we do?

Distal Airway Foreign Bodies

- IV Decadron at high dose (1 mg/kg/dose Q 8 hours X 6 doses)
- Endoscopy repeated 48 hours later

Distal Airway Foreign Bodies

- The inflammation had resolved and the tooth had shifted positions to a more accessible left lower lobe tertiary segment.
- Child intubated!
- Now what do we do?
Distal Airway Foreign Bodies

- Disposal flexible urologic equipment was tested
- Disposable flexible bard urologic instruments

Distal Airway Foreign Bodies

- Multiple port endotracheal tube adaptor
- TESTED THE EQUIPMENT “EX VIVO” FOR FIT THROUGH THE ET TUBE!!!

Distal Airway Foreign Bodies

- Using fluoroscopy with guide wires through the endotracheal tube, the tooth was removed.
- Fluoroscopic retrieval using Fogarty catheter.
- AVOIDED THORACOTOMY!!!
Distal Airway Foreign Body Algorithm

- Rigid bronchoscopy is not always the answer
- LMA/endotracheal tube intubation needed for protracted extractions
- Best role for radiology is a “set of eyes” in the distal airway where fluoroscopy “sees” better than we do
